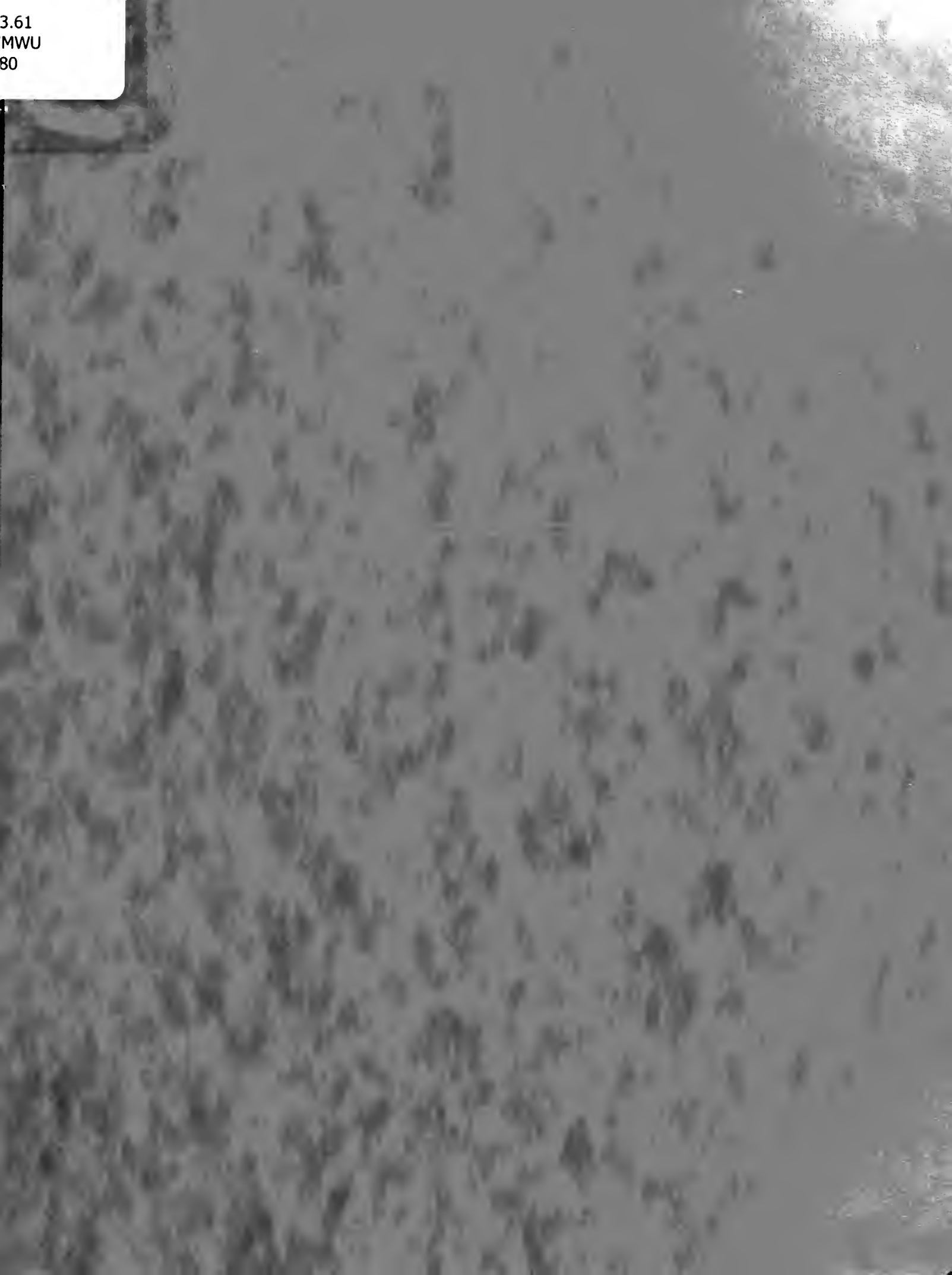

THE MONTANA WATER USE DATA SYSTEM

A Proposal to
The United States Geological Survey

From The
Montana Department of Natural Resources and Conservation

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

Background. Increasing demands on Montana's water resources have focused attention on the fact that the continued well-being of this state depends heavily on its water resource. Care must therefore be taken to ensure that this resource is properly managed and wisely used, and that adequate supplies of good water are available in the future. Planning and management necessarily depend on adequate, reliable information, which must be readily available and regularly updated. Readily available data on water resources and water use will greatly improve the quality of water resource management, and reduce the social and economic costs of decisions based on inadequate information.

Comprehensive and reliable water resource information is not a luxury, but an essential investment in the future of Montana. The Montana Legislature acknowledged this imperative in passing the state's Water Use Act. That law requires the Department of Natural Resources and Conservation (DNRC) to prepare a continuing and comprehensive inventory of the state's water resources and to collect, organize and disseminate information on water use.

A critical shortage of water use data exists at both the national and state levels, and the U.S. Geological Survey (USGS) Water Resources Division has therefore undertaken a program to collect, organize, store and disseminate data on water use throughout the country. This program matches state with federal funds for water use data collection, organization, storage and dissemination programs. With the financial support of USGS, Montana will be able to compile a data base adequate for sound management of the state's water resources.

Scope and Objectives. A Montana Water Use Data System (MWUDS) is envisioned by the state as a part of a larger Water Resources Data System (WRDS) which would include water supply, water quality and water-use information.

The primary object of this proposal is to request financial aid from USGS to begin developing the MWUDS portion of WRDS. The proposed tasks are presented in the FY 1981 program plan (Section IV).

The MWUDS is proposed as a water use management and planning tool. Its objectives are:

1. To collect, organize, store and disseminate water use data that complement data on the availability and quality of the state's water resources;

2. To develop and operate water use systems that are responsive to the data needs of users at both the national and state levels; and

3. To provide information for the optimum use and management of Montana's water resources.

II. FUNCTIONAL DESIGN

The Virginia, Kansas and Idaho water use data systems were reviewed to determine whether existing water use systems are applicable to Montana (these three systems are assessed in Appendix A). Virginia was selected because its water use data system is the most comprehensive; Kansas, because of its strong emphasis on water rights; and Idaho, because its water use development is similar to Montana's. The Virginia system was more complex than needed at this stage of development, while the Kansas system was too narrow in scope for Montana's requirements. The

assessment indicates that the Idaho system, as currently being modified, is most appropriate for adaptation to Montana.

The following features are the foundation of the Idaho Water Use Data System:

Data Acquisition

Data Input

Data Retrieval and Analysis

Data Maintenance

Information Output

Information Use

These features have been adapted to define the five basic functions of the MWUDS program, as follows:

Data Collection

Data Organization

Data Storage and Retrieval

Data Maintenance

User Access

Several of the state agencies that will be contributing to MWUDS have already developed systems capable of providing these five basic functions for some types of water-use data. This makes the concept of a decentralized system more practical

than a centralized system, since a decentralized system would use these existing systems instead of creating a centralized system in which existing data might be duplicated.

Schematics of the five functions, and the relationships among them are shown in figures 1 through 6. Data collection and organization can be initiated immediately and coordinated with existing programs. An initial step is to assess current data needs and data systems. State and federal systems currently in use are reviewed in Appendix B. This review shows what data are available and what data are needed in Montana. The MWUDS should concentrate on these functions as part of the startup effort (FY 1981 program). As data are compiled and formats are developed, the program can move into a long-term mode of operation, providing computer storage and retrieval capabilities, data maintenance software and user access. In addition, the long-term program will continue to update the data files with new water use information as they become available.

1. Data Collection. In this phase the system gathers the data that water users and resource managers will need now and in the future. Thus, a part of the MWUDS is the design of data collection programs and their implementation. These programs will involve data not currently being collected as well as collected data not currently available to the water resource community (figure 2).

2. Data Organization. This function links the Data Collection Function with the Computer Storage and retrieval function. This part of the MWUDS ensures that data will be organized in a manner that benefits the Montana water resource community and also meets the needs of the USGS. Input forms for data from the Data

Collection Function, and methods for linking the MWUDS with other existing computer systems will be developed (figure 3).

A. Hardware. Various agencies have their own data processing systems for data entry, telecommunications capability and various levels of data handling. The data handled by these agencies are generally stored on tapes, hard disks, or floppy disks and in a form unique to the particular computer system.

Figure 1. SYSTEM CONCEPTUAL SCHEMATIC

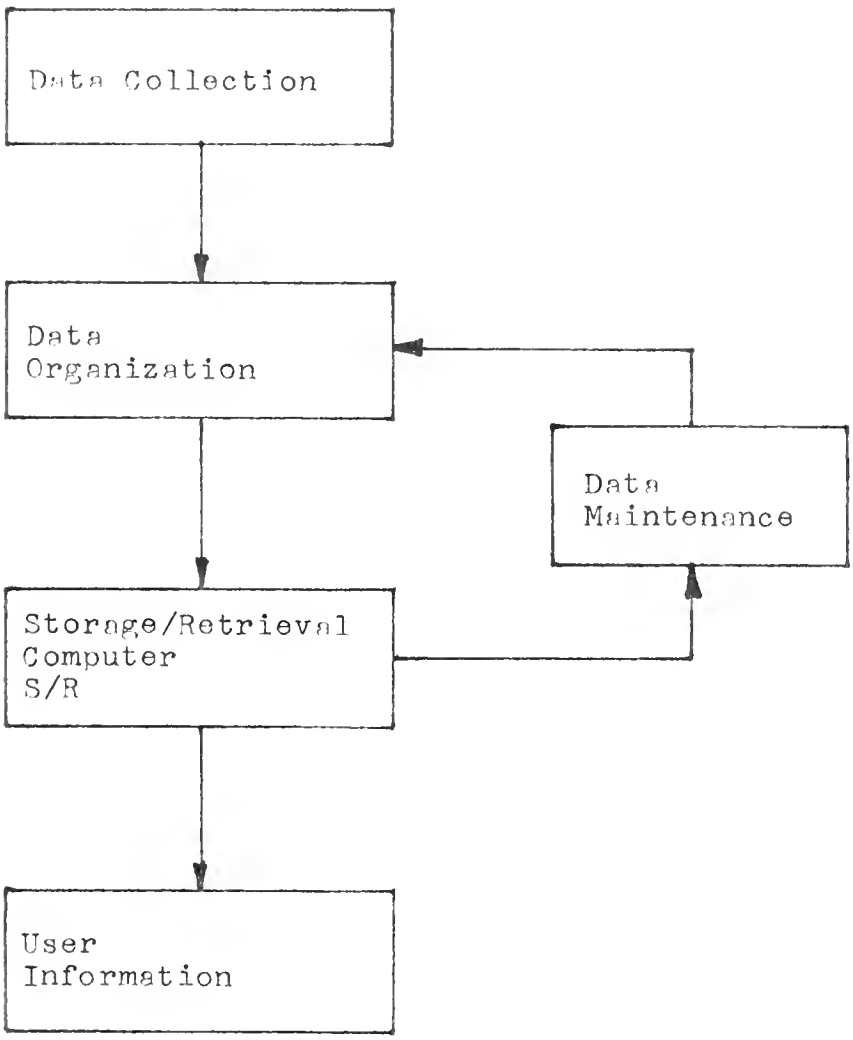


Figure 2. DATA COLLECTION CONCEPTUAL SCHEMATIC

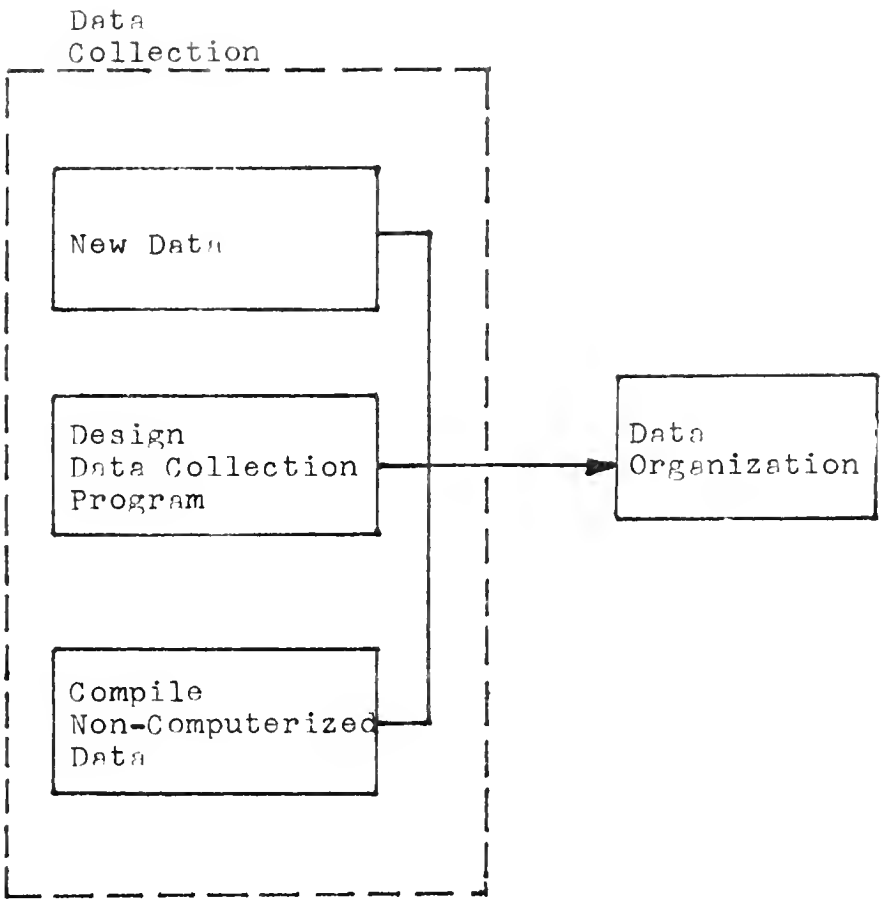


Figure 3. DATA ORGANIZATION CONCEPTUAL SCHEMATIC

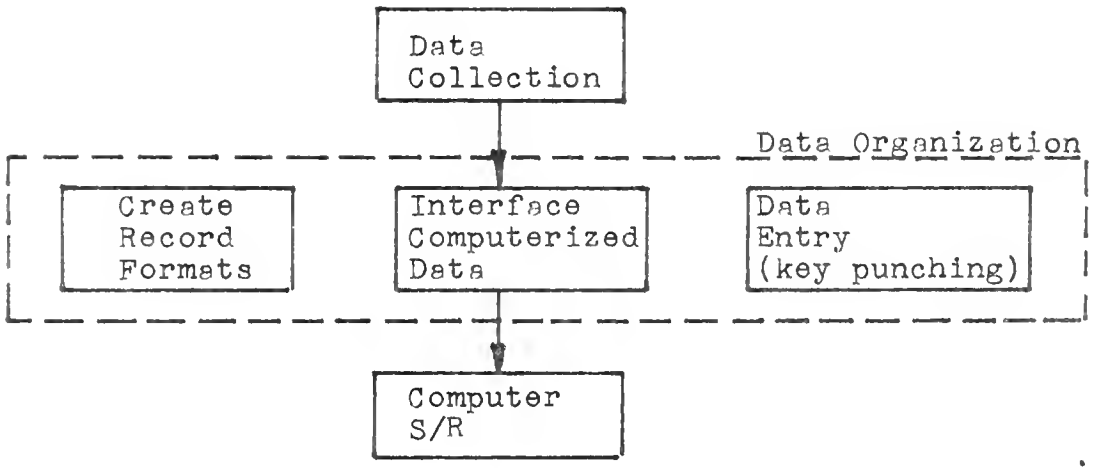


Figure 4. COMPUTER STORAGE/RETRIEVAL CONCEPTUAL SCHEMATIC

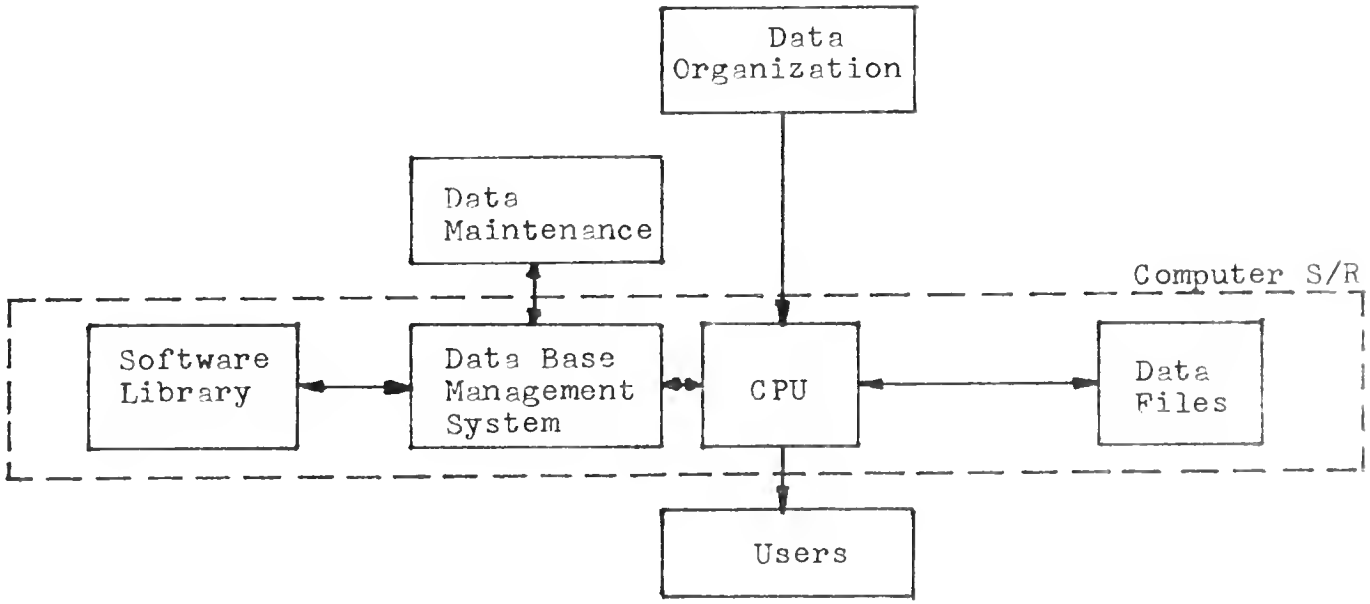


Figure 5. DATA MAINTENANCE CONCEPTUAL SCHEMATIC

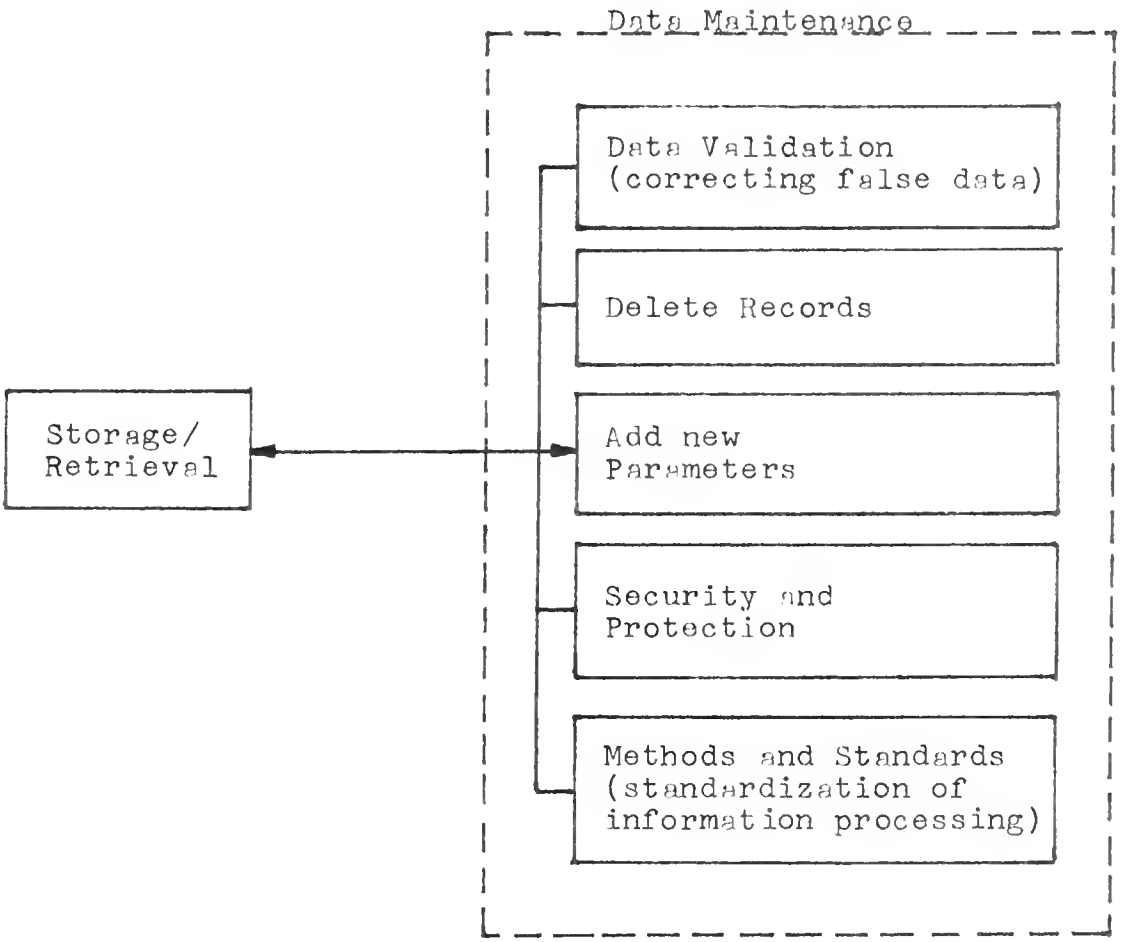
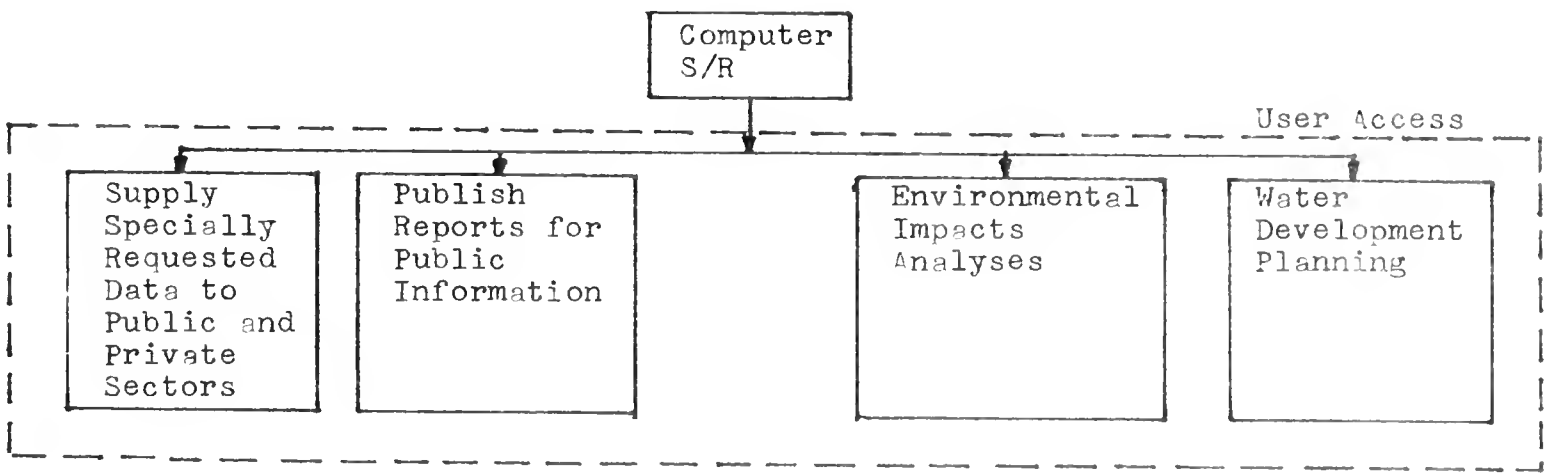


Figure 6. USER ACCESS CONCEPTUAL SCHEMATIC



Occasionally one agency's hardware is incompatible with another's . Hardware/software/interfaces needed to solve this problem will be identified during the development of the overall system.

B. Software. Generally, hardware incompatibilities can be overcome using software or telecommunications equipment. The Montana Department of Administration (DOA) has developed software for converting data processed by other computers into the IBM format required by the state's computer system, and vice-versa.

The existing data are often in manually retrievable form and must be converted for computer retrieval. Also, computerized data now in varying formats need to be standardized. Software programs will be written to read and convert such data to a standard format.

3. Data Storage and Retrieval. The Storage and Retrieval function accepts data from the results of the Data Organization function and stores it on tape or disk (figure 4). The retrieval portion of this function must allow the data to be retrieved in a variety of ways, in a timely fashion and at a reasonable cost. The type of retrieval (e.g., annual reports, monthly summaries) should satisfy the system users, including the USGS. Retrievals may also be in the form of raw data or computer media (e.g., tape, diskettes, cards) to allow for independent analysis.

A. Hardware. Existing hardware includes two IBM 370/158 computers, tied by an interactive mode, which will act as the central processing unit (CPU). The system stores data on tape or disk, and can be accessed by terminals. Output capabilities include graphics, remote terminals and high speed printers. A number of agencies already have smart terminals or minicomputers capable of processing data either before or after entry to the CPU.

B. Software. Software requirements include data updating, retrieval and conversion, and a data management system. The update software must be available to add new data, and to check for data entry accuracy. Retrieval software has to be developed to retrieve data, to create computer files and to prepare reports. Generally, user demand will govern the retrieval software to be developed.

A data management system (DMS) will be used to control interactive data retrieval, the changing requirements of data being stored and the complex relationships among data elements. The DMS should have good privacy and security control, good data recovery routines and a central access monitor program.

4. Data Maintenance. The reliability and utility of the system are only as good as the data it contains. Therefore, this function validates the input data to ensure reliability (figure 5). Also involved in this function is the system operation. Since the system as a whole is dynamic, changes in operation must be easily facilitated to provide better information to the users. The system must also be protected from accidental or malicious removal or changing of data. This function will develop procedures and safeguards to protect each agency's data files.

A. Hardware. Several choices of hardware are available including a terminal, a minicomputer with terminal capabilities and direct use of the DOA system (batch processing). Most agencies have a remote terminal that can be used for interactive data processing and, depending upon need, could have minicomputer facilities.

B. Software. Although a great deal of existing data are already in computer format, the format may not meet the standards required by the MWUDS. Other data available in card format may contain coding or keypunch errors. Also, such water use information as location, owner or identification number may need to be changed, or new parameters may need to be added to old records. Occasionally records become obsolete and need to be deleted. Editing software will be required to validate and upgrade these input data.

5. User Access. The primary purpose of the MWUDS is to serve as a storehouse of water use data that will be available to those who need such data (figure 6). A substantial number of requests for data is anticipated, and ready access must be provided. Principal users of the system will probably be the various state agencies contributing water use information. These agencies should be able to access the stored information directly. Private users could have access through one of the participating state agencies, or be allowed direct access for data retrieval only. An education program must be available to MWUDS users, including training for first-time users and refresher courses as new capabilities become available.

A. Hardware. Users have essentially the same choices of hardware as maintenance personnel. Hardware possibilities include direct use of the DOA system (batch), agency or privately-owned minicomputers, and remote terminals.

B. Software. A software package with instant retrieval capabilities and English-like commands is necessary if noncomputer-oriented users are to access MWUDS data conveniently. Also, data summaries are frequently required for planning and management. Software must be developed to generate "standard"

summary reports, including statistical summaries, trend and forecasting reports.

Each user will be responsible for developing software for special reports and other specific needs, though users would have the option of asking MWUDS personnel to develop special software needed for special analyses. Development would depend on time requirements and funding commitments.

III. WATER USE DATA ASPECTS

Water Use Categories. The first step toward recognizing the type of information the system must handle is to categorize the types of water use. The following list of major water use categories includes those suggested by USGS and others that are important to Montana.

Water Use Categories

Domestic

- Municipal
- Residential
- Commercial
- Public (rest stops, camping areas, visitor centers)

Agricultural

- Irrigation (flood, sprinkler, subirrigation, water spreading)
- Stockwater
- Pesticide application

Industrial

- Process water (food, chemical source, steam, washwater, canning)
- Cooling water
- Oil well flooding
- Deep well disposal
- Mining (dust control, road construction, dewatering,

solution mining, concentration and rock cutting)

Slurry transport

Reclamation

Hydroelectric and peaking power

Navigation

Recreation and Wildlife

Fish and wildlife

Swimming

Boating

Instream flows and evaporation

Hatcheries and raceways

Treaties, Compacts, and Transfers

Groundwater Recharge

Data Elements. Once an exhaustive set of categories has been established, the elements or attributes necessary for describing and quantifying specific uses are determined. These basic attributes become the data elements that are to be collected, organized, stored, retrieved and maintained by the system. Some of these data elements are currently being collected and may even be elements of another system. Others are not being collected and may not be for some time. The system will provide for all of these elements, and others that may be added later.

All the data elements required to characterize a specific use form a record. A typical record consists of two basic parts: first, permanent data, including station location, identification number, design capacities and any permits involved, and second, a series of smaller records containing the fixed station identification numbers, a date and time, and values of parameters that correspond to that time. An example of a typical record for industrial process water use is shown below in figure 7.

Figure 7. TYPICAL DATA RECORD

RECORD TYPE: Industrial Process Water

Record Code (ID #). IPW 80-134
Location
  Source map USGS Myers
  TRS 7 N 44E 12 ABCD
  Lat/Long 46 26 35 105 48 36
  State code MT
  County code 79
  City code 0
  Name Montana Electric Company
  Address Box 98756
  Billings, MT 59101

Basin Code 41 KJ
  State code 28
  Federal code 16

Ground water 0
  Aquifer code 0
  Casing type 0
  Casing diameter 0
  Well depth (MSL) 0
  Static water level (MSL) 0
  Surface elevation 0
  Storage coefficient 0
  Transmissibility 0

Surface water
  Stream, reservoir,
   lake designation Yellowstone River

Design Criteria
  Intake capacity 20 CFS
  Storage capacity 2000 Acre Feet
  Distribution capacity 5000 GPM
  Population 6000 (per capita equivalent)

Treatment type 4 (settling, phosphorus removal)
Population type 6 (transient)

Permits
  Water right MT - 1234/021472
  Regulator agency WQB/DHES
  Permit type and number MT-0026724

Remarks water is used for coal gasification, pumps cooling, and domestic supply.

FIGURE 7 (continued)

ID#,Date, Time	I PW80-1234 041874 1345
Parameter code and value	0061 22.4 (instantaneous flow =22.4cfs)
Measuring method	4 (power consumption)
Measuring accuracy	2 (on a scale of 1 to 5)
Sampling agency	MEC (Montana Electric Company)

Data Base Management. The manner in which the data elements are stored and retrieved by the system is an important aspect of system utility. A number of data management systems are currently being used but none of them is completely adaptable to the preferred arrangement of data elements for this system. However, there are three data base management systems in current use that should be investigated. They are: SYSTEM 2000, Information Data Management System (IDMS) and the Montana Department of Highways Information System (HIS).

SYSTEM 2000 is used by the USGS and a number of private companies. It has been adapted by the USGS for water resources data and could be further refined to manage water use information. The IDMS is now used by the DOA for some water resources data handling by state agencies. The HIS was developed by the Montana Department of Highways for use on the IBM 370. This system should also be adaptable to water resource data. All three systems require at least an average level of data processing expertise for support personnel. The final decision on which data management system to use will be made during the development of the overall MWUDS program.

IV. PROPOSED FY 1981 PROGRAM

General Overview.

The previous sections of this proposal have addressed the overall concept of MWUDS, which the state of Montana wishes to develop eventually. All aspects of the system cannot be initiated at this time, however. Due to the lack of water use data in Montana, data collection and organization were generally given a higher priority than computer storage/retrieval and user information. Furthermore, a number of state agencies have already developed computer storage/retrieval systems. These can handle new water use data until the MWUDS computer storage/retrieval segment can be developed, and they do provide user access that may satisfy the current needs of both the state and USGS. However, some general agreement between agencies will be needed concerning the format for data collection and organization.

The following water-use data were selected for the initial collection and organization effort. This selection was based on the need for the data, and the cost of collection and organization.

1. Groundwater use

2. Municipal and industrial water use

3. Irrigation diversion and return flow water use

4. Enhanced oil recovery water use

The collection effort begun in these areas would be continued as funding becomes available. If additional funding becomes available, these activities could be expanded or the collection of other data could be added. In addition to these

four activities, the Department of Natural Resources and Conservation (DNRC) will continue to collect and process water-use data associated with the state water adjudication program (see the Preliminary Proposal to the USGS; Montana Water Use Data System).

Description of Activities

1. Groundwater Use. The use of groundwater in Montana is fairly extensive but documentation of the amounts used are generally lacking. Increasing requests for development of groundwater in the state have emphasized the need for groundwater-use data. A proposed program would complement the current Montana Bureau of Mines and Geology (MBMG) work on groundwater aquifers. This is an aquifer inventory, including identification of groundwater and its abundance and quality. Water use data collected by the MBMG and supported through the MWUDS program would supplement the results of this work.

Specifically, MWUDS funds would be provided to the MBMG for collecting water use data as an addition to the Bureau's ongoing project. This will generally be area-specific rather than low density and statewide in scope. Since an intensive survey of groundwater use in an area is needed to determine potential impacts, even a limited amount of data is useful if collected in a specific area. This collection activity is envisioned as ongoing and new areas will be selected for monitoring in subsequent years.

The new data to be collected will be in the form of cumulative time of operation and pump characteristics. Vibration Time Totalizers (VTT's) will be used to measure the time between two dates (say monthly) for which a pump was operating. This information coupled with well and pump characteristics can then be used to

estimate water useage. Information concerning location, ownership, and aquifer and well characteristics will also be collected.

Currently, both MBMG and USGS organize data in a format designed for their specific computer storage/retrieval systems. Either of these could be used or slightly modified to provide the necessary organization of new water use data. Similarly, either of these computer sytems could be used for the storage/retrieval function until the MWUDS computer storage/retrieval component can be developed. The important tasks at this time are to collect data and organize it in a computer format.

2. Municipal and Industrial Water Use. Data on the amount of water used by the various industrial and municipal users in the state is also generally lacking though similar information is probably being collected by some of the larger users themselves. The larger municipalities, for instance, have good records of water-use that should be readily available.

The first phase in the collection and organization of data in this category will involve the distribution of questionnaires. Generally the questionnaires are designed to ascertain the type, quality and availability of water use data. Examples are shown in figures 8 and 9. Such data elements as date, time, type of parameter, measuring method and measuring accuracy are important attributes of municipal/industrial water use information.

Figure 8.

MUNICIPAL WATER USE SURVEY

Name of City: _____
Mailing Address: _____
State, Zip Code: _____ County: _____
Person Responding: _____ Title: _____

I. Source of Water Supply: (Percentage A through D should equal 100%)
A) Privately-owned water companies _____%
Sources of water _____
B) Public-owned water companies _____%
Sources of water _____
C) Privately-owned wells _____%
D) Other (Please specify) _____%
_____
_____
TOTAL 100%
E) What percentage of the above water is chlorinated? _____%

II. Storage Capacity:
What types of water storage facilities are available to your municipality? What are their capacity?

Storage Facility	Capacity in Gallons or Acre Feet (Specify)
_____	_____
_____	_____
_____	_____
_____	_____

How was construction of these facilities funded? _____
_____

III. Supply Adequacy:
A) In your best judgement, considering water conservation, advanced technology and automation, cost of water, statutory requirements in water quality, and other modifying influences, what changes in water supply do you expect for your municipality from the present level of use, over the next 10 years? (100 % would indicate the same level as present) _____%
B) Are there any new facilities under construction?
Yes _____ No _____
If yes, how many? _____
C) How are these new facilites being funded _____
_____
D) In 1977 did your municipality have a shortage of water during the drought?
Yes _____ No _____
If yes, what were your water needs beyond the available water supply (100% would indicate the same level available in 1977 _____%)

E) Has your municipality made any changes to its water system due to the 1977 drought?
Yes _____ No _____
If yes, specify what kind of changes you made and why you made them.

_____

_____

How were these changes funded: _____

_____

F) Did your city identify any needed changes in its water system due to the 1977 drought which you have been unable to make?
Yes ____ No ____
If yes, identify the needed changes: _____

_____

_____

IV. Water Demand:

A) Residential Sector

1. Number of residences supplied water?
   Single-family _____
   Multi-family _____
2. Average amount of water supplied to each residence.
   Peak month _____ gal/household day
   Average month _____ gal/household day

B) Commercial Sector

1. Number of commercial establishments supplied with water:

_____

2. Average amount of water supplied to each commercial establishment: _____ gal/establishment

Figure 9

INDUSTRIAL WATER USE SURVEY

I. Water Intake(please give 1980 figures): SELF-SUPPLIED PURCHASED

A. Processing _____ _____
B. Cooling and condensing _____ _____
C. Boiler feed _____ _____
D. Employee/sanitary _____ _____
E. Air conditioning _____ _____
F. Other _____ _____
TOTAL ANNUAL WATER INTAKE: _____ _____
G. Water intake was measured in 1)Acre-feet, Yes___ No___; or 2) gallons, Yes___ No___; or 3)Other _____
H. Water intake was measured by 1)Meter, Yes___ No___; or 2)Sample, Yes___ No___ or 3)Estimate, Yes___ No___; or 4)Other _____

II. Water Source(if more than one source, please identify which source you are referring to by circling the corresponding number)

A. Names of sources 1. _____
2. _____
3. _____

B. Type of source Source(circle one) % of total water intake

Well & Spring____	1	2	3	_____
Streams____	1	2	3	_____
Lake____	1	2	3	_____
Water Purchased____	1	2	3	_____
TOTAL100%				_____

C. What percent of the water is treated before use?_____%
What type of treatment was used?

Aeration	_____	Softening	____	Prechlorination	____
Waste order	_____	Coagulation	____	Iron removal	____
Sedimentation	_____	Ammoniation	____	Filtration	____
Fluoride adjust.	_____	Corrosion control	____	Disinfection	____

Other _____

D. Do you reclaim water? Yes_____
If yes, what percent of your water intake is reclaimed?_____%

III. Water Discharge

A. What amount of water was discharged back into your source of supply?_____
B. Was this water treated before it reentered the water source?
Yes _____ No _____

C. How was this water treated?

_____ PRIMARY - The removal of settlable solids (screens, gravitational settling, etc.).

_____ SECONDARY - The reduction of biochemical oxygen through biological digestion to yield stabilized sewage.

_____ TERTIARY - The removal of organic or inoraganic wastes by methods other than primary or secondary.

_____ DOMESTIC - Drinking water treatment.

_____ OTHER - _____

IV. Future Water Demand

A. In your judgment, what change would be expected to occur in your level of production over the next 10 year? _____%

B. Considering water conservation and recirculation, advanced technology and automation, cost of water, statutory requirements in water quality discharges and other influences, what changes in water user per unit of production do you expect over the next 10 years? _____%

Data on pump characteristics, intake capacity and service population may be readily available, but of little utility unless use rates are also available. Similarly, an industry may have good records on water use but may not choose to make them available because of confidentiality or for process design reasons. Thus, the information received on the questionnaires will guide the development of the actual acquisition of municipal and industrial water use data.

Acquiring, compiling and organizing municipal and industrial water use data is the second phase. The compiled and organized data can be made available to municipalities and industries as an incentive for their participation. Currently, some information on water used by the various municipalities and industries is available from such state agencies as the DNRC and the Department of Health and Environmental Sciences (DHES). Through the permitting process for water rights and waste water discharges, data on ownership, location, type of water use and design criteria have been gathered. Generally, the data collected in this second phase will refer to the specific amount of use rather than the type of use. Once established, this collection activity will be continued in subsequent years. The continuation and an enhancement will depend heavily on the availability of funds.

Currently DNRC and DHES organize data in formats designed for their specific computer systems. These existing formats may provide the needed organization and the storage/retrieval systems currently in operation may be sufficient for the MWUDS effort presently contemplated.

3. Irrigation Diversion and Returnflow Water Use. Since Montana is an agricultural state, irrigation comprises a major portion of the state's total water-use. Water-use data in this area has been minimally available; however, some

good records of diversion data are being maintained by certain independent irrigation districts and by federally sponsored districts as well.

The first phase of compiling and organizing data elements in this category will involve questionnaires, similar to those designed for municipal and industrial water use. The questionnaires for irrigation water will be used to determine the type, quantity and availability of water use data. The information received on the questionnaires will be used to determine what data elements can be obtained and what their priority of acquisition should be.

Compiled and organized data can be offered to districts to encourage them to participate in the program. Irrigation diversion information pertaining to state-owned water projects is currently available from DNRC, but it refers to the location and type of water use rather than to specific water useage. The emphasis of this effort will be on specific water use data such as diversion rates. Some of the districts have also begun to monitor return flows. Where available, these data will also be sought.

In this initial portion of the MWUDS program, emphasis will be placed on diversion and return flow data that already exist, but have not been compiled and organized. No adequate organizational computer formats are available for use with diversion and return flow data at the state level. An organizational format will have to be developed for data in this category, generally following the guidelines set forth in the data organization section of the MWUDS functional design. The information will then be stored sequentially on tape or disk. This will not provide the retrieval and general user utility of the ultimate system. However, using existing data system facilities in state agencies will allow use of the data prior to completion of MWUDS.

4. Water Use for Enhanced Oil Recovery. The oil industry is one of the largest industrial water users in the state. Each year enhanced oil recovery operations use water at the rate of approximately 10 million gallons/day, mainly for water flooding. Some of the water is produced with oil and recycled by injection, but, a large amount of water is produced from fresh water aquifers. Also, where secondary recovery operations are not feasible, excess produced water is often injected into disposal wells.

These water use data will become more critical as groundwater resources become more developed. The Montana Oil and Gas Conservation Division (OGCD) collects water production, injection and disposal data from all oil field operators in Montana. These data are now available in a standard paper format and OGCD is planning to computerize the files. Efforts will be made to coordinate this program with MWUDS and facilitate the data conversion. The USGS or MBMG groundwater data handling systems could be used for the computerization and storage of oil field water use data.

Project Organization and Management

1. Administration. The current MWUDS steering committee will continue to function as an executive committee to the project. It is extremely desirable to keep this committee composed of representatives from the various state water resource agencies, because this will ensure that the project proceeds in a user-oriented direction. The purpose of this effort is to make water use information more readily available to those who need it for water resource management. For this reason, those people and agencies must be regularly involved in the operation and management of the program. A process to inform and educate agencies and other user entities as to the objectives and function of the program will be initiated.

This education effort will intially focus on agencies or groups providing data to the MWUDS. The executive committee will be responsible for the general functioning and direction of the program. The establishing of program objectives and guidelines will be a major committee effort. They will also be cognizant of additional sources of funding that would permit a broader scope of activity than the current funding will allow.

For the day-to-day operation and management of the program the executive committee will need to hire a project manager. The project manager will be responsible for seeing that the program objectives as set forth by the executive committee are met. The project manager will report to the executive committee on the progress and problems of the program, and will be responsible for budget maintenance. The project manager will be required to be knowledgeable in data collection design with some understanding of data processing. An appreciation of how the information is to be used will be required so that the project manager can determine the priority of water use data that will be collected through the program. In addition, the project manager will be responsible for documenting procedures for compiling, organizing and storing the data during the project duration.

Certain state agencies --DNRC, Department of Community Affairs (DCA), DHES, MBMG and the Montana University System-- will become more involved in the project than others, due to the types of data being collected and the adequacy of their data handling facilities for accommodating water use information. For example, MBMG will be involved because they will be collecting groundwater use data. The project staff will work closely with these agencies to ensure an effective data collection design, compilation and organization, while the agencies will have the

added responsibilities of collecting, compiling and organizing the specific water use data.

2. Operation. The schedule of activities for categories in which water use data are to be collected are shown in figure 10. As indicated on figure 10, this is to be an on-going program that will require future funding for assuring that it is properly maintained. Since future funding levels are uncertain at this time, only the continuation of the currently proposed program is projected. Assuming that funding for the 1981 MWUDS program will be available in November, 1980, the following agenda has been developed:

September 1980 - Submit MWUDS plan to the USGS

October 1980 - Initiate action to hire program manager (e.g. prepare position description and advertise; actual hiring deferred until funding is made available)

-Initiate program budget amendment process

-Develop general tasks for program manager

November/December 1980 - Process program budget amendment and hire program manager.

December 1980 - Executive Committee review of general operations plan for 1981 (prepared by the Program Manager).

January 1981 - Finalize operations plan, design forms and collection system. Commence data collection.

July 1981 - Commence preparation of 1981 activities report and 1982 program proposal.

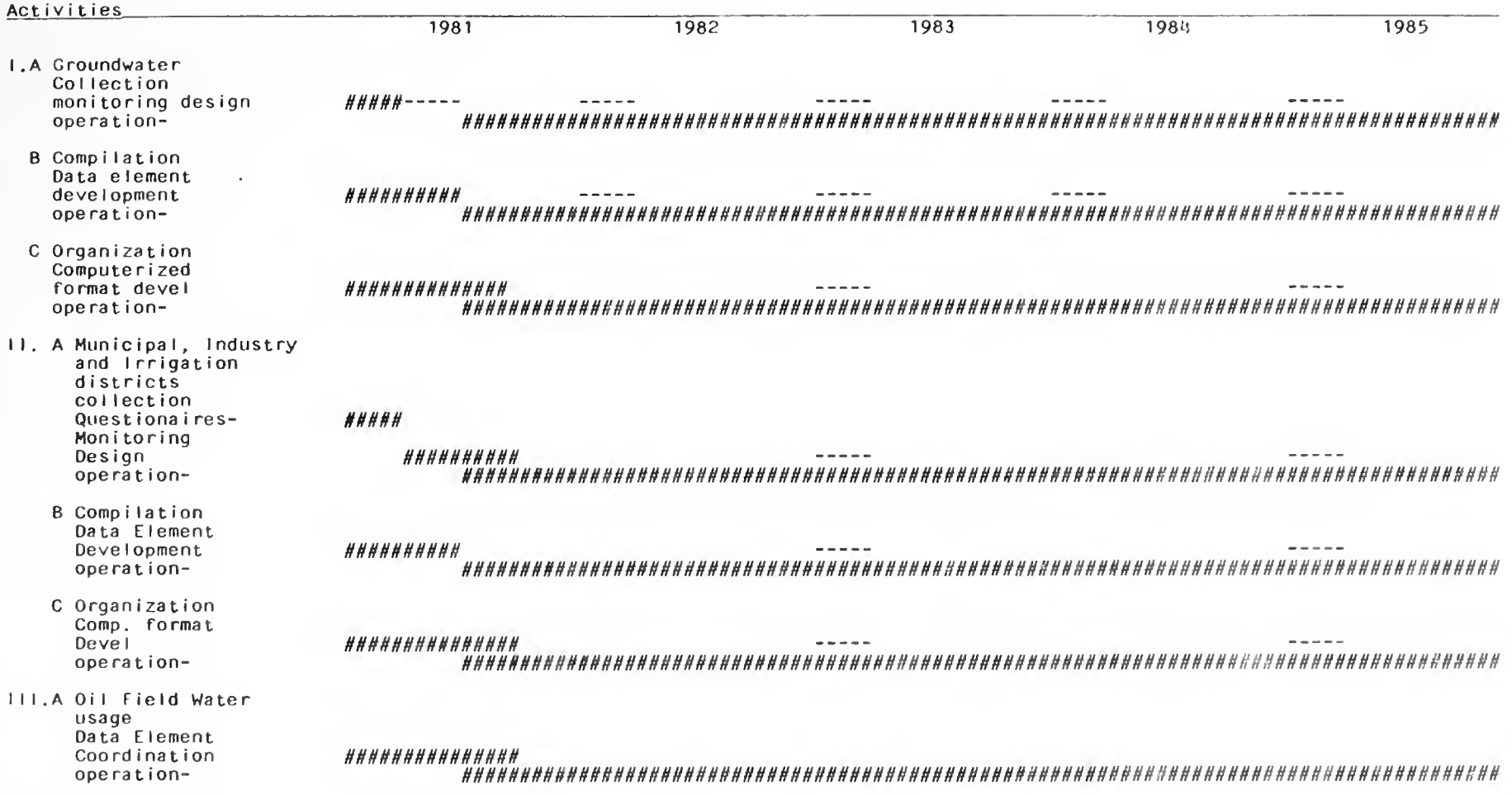
August 1981 - Executive Committee review of draft report and proposal. Finalize report and proposal.

September 1981 - Submit 1982 program proposal to the USGS.

The executive committee and project manager, in conjunction with DNRC and MBMG, will select an area in which the groundwater use data will be collected. A monitoring system will be designed for compatibility with the MBMG's's ongoing aquifer inventory. The MBMG will then do the actual collection of raw data. These data will be compiled to yield water use data elements (e.g. average monthly gallons/minute). The project staff will develop forms for recording raw data and compiling of water use data. Once the methods have been developed, the staff do the compiling. Organizing the data for computer processing will require input forms. The staff will develop these forms in consultation with MBMG to facilitate the use of their computer storage/retrieval system.

MBMG has indicated that it can collect the groundwater data concurrently with ongoing or planned projects, though they will require additional money for data entry, computer time, equipment, travel and personnel expenses. Funding will also be required for the project manager to coordinate the data collection, organization, and ultimate entry into MWUDS.

FIGURE 10. Activities 1981 through 1985



---- indicates periods of reassessment and design revision

The project manager will also develop the questionnaires that will be sent to municipalities, industries, and irrigation districts. As the questionnaires are returned, the Project Manager will develop a list of priority data elements that should be collected for each group of water users. For example, municipalities might be asked for data on intake capacity, daily or monthly average pumping rates, storage rates, population served, distribution capacity and current permits. Irrigation districts might be asked for data on acres of irrigated cropland, diversion structure capacity, typical months of operation, actual diversion volumes and rates, source of water, and return flow rates. Depending on the business, industrial users could be asked to supply intake and storage capacities, actual pumping rates, period of use, source and other data.

The use data could be acquired by asking the particular user for the data, or through staff visits to the municipalities, districts or company headquarters. Staff interviews are preferable because they provide better feedback on data needs and availability of water-use data, and because they increase the likelihood of obtaining the data. Talking to individuals now recording use data in the field will prepare the project manager for developing the data organization and user access requirements of the MWUDS program.

Developing questionnaires and conducting followup requests and staff interviews will require a minimum of one man-year, including approximately 150 days of per-diem and related travel expenses.

The project manager will coordinate activities with the Oil and Gas Conservation Division (OGCD). The object being to maintain good communication between OGCD and the executive committee, and thus to ensure computer format

compatability with MWUDS. This function should require about one man-month of staff time during FY 81.

3. Budget -- Fiscal Year 1981

Budget Category	USGS Funds	Reverse Flow Funds to DNRC	State Matching Funds
a. Personal Services			
- Project Chief(USGS)	$19,000		
- Project Manager(DNRC;1FTE)		$17,685	
- Computer Analyst(DNRC;1FTE)			$18,548
- Keypunchers(DNRC;2FTE)			18,450
- Records Supervisor(DNRC;.5FTE)			8,097
- Adjudication Specialists(DNRC;1FTE)			14,284
- Records Technician(DNRC;.25FTE)			3,023
Fringe Benefits (20%)		3,537	12,480
Total Personal Services		21,222	74,882
b. Contracted Services			
- Computer costs		2,000	10,000
- Agency data collection		17,000	
- Data compilation assistance		10,500	
Total Contracted Services		29,500	10,000
c. Supplies and Materials			
- Office supplies		700	
- Copying expense		1,500	
Total Supplies and Materials		2,200	
d. Travel			
- Mileage/fares	600	5,500	3,000
- Per diem	400	3,800	2,200
Total Travel	1,000	9,300	5,200
e. Capital Equipment			
- Office equipment		1,000	
Total Capital Equipment		1,000	
DNRC Indirect Costs (10.57%)		6,682	
TOTAL PROGRAM EXPENSE	$20,000	$69,904	$90,082

APPENDIX A

AN ASSESSMENT OF THREE WATER USE DATA SYSTEMS

Assessment of the Virginia Water Use Data System.

The Virginia Water Use Data System (VWUDS) is one of three prototype systems launched by the U.S. Geological Survey (USGS) as a basic building block for its National Water Use Data System. A task force representing federal, state, local, and private interests was appointed to propose a system for Virginia. A series of reports has been organized into a proposal (1).

Summary of VWUDS.

The VWUDS program is a joint venture between the Commonwealth of Virginia and the USGS. Its purpose is to collect, store, and disseminate water use data for policy, planning, budgeting, and management of water and land related resources. The system is owned by Virginia. Aggregated data will be made available to the National Water Use Data System (NWUDS) housed in Reston, Virginia on an annual basis. VWUDS is a prototype model (not a final design).

Through the offices of the Governor, each State Agency will be asked to participate in the program. The State Water Control Board, the Department of Health, and the Department of Agriculture and Commerce are the lead agencies during the task force study. The State Water Control Board, under cooperative agreements with the USGS, will implement the system by 1982.

The system is centralized. It will probably not reduce taxes, but it will probably improve the quality and quantity of data and make it easier to obtain. Data will be collected from state and federal agencies with existing programs. A data base management system (DBMS) may be housed at one of the state universities or at a state Department of Computer Services site.

VWUDS is not intended to be a stand-alone system, but rather an integral part of a statewide network of related systems, fully automated with terminals.

Interfacing with NWUDS and other federal agency systems will be developed. Existing hardware and software will be used where possible, and a phased approach to bringing hardware on line is recommended. Flexibility to accommodate future innovations is of utmost importance.

Thirty-four DBMS's were investigated; the most promising are ADABAS, DBMS-1100, IDBMS, and IMS. ADABAS has the most favored features. An additional system, DM-IV/I-D-S-II is relatively new and appears to be very good, but it only runs on Honeywell computers of which there are none in Virginia.

The prototype data elements dictionary is organized into data categories. A data element defines a particular type of information that is to be stored, e.g., annual rate. A data category defines the specific system component for which data are to be stored, e.g. surface flow.

The DBMS must be able to supply answers to five types of questions:

1. General - "How much water was withdrawn for agriculture?"
2. Specific - "What is the type of crop irrigated?"
3. Cumulative - "What are the total withdrawals by all users in a certain county?"
4. Basic - "What is the volume of a given lake?"
5. Compound - "What were the total withdrawals minus the total returns?"

Water use/inventory is defined in terms of point, reach, and area and each is located by latitude and longitude.

The "top-down" (macro-to-micro) approach was used as the method of preparing the VWUDS project management plan. Nine major functions were identified. Each was divided into tasks and the tasks were divided into activities.

Critique.

Commendable Features. VWUDS when implimented will provide immediate access to water use and related data on a local, regional, and national basis. The system is centralized so that tighter control can be maintained especially in the areas of standardization and security. The use of existing hardware and software where possible will help to reduce high initial costs, especially if the suggested, phased approach for bringing hardware on line is employed. The recognition of the need for flexibility so that innovative ideas might be explored is particularly attractive. The use of a "top-down" approach indicates an awareness of systems analysis and the need for methodical definitions.

Questionable Features. The VWUDS is far too complex for its infancy. Very extensive data categories refer to an amorphous structure involving both water and land use. The data system will be difficult and costly to implement by its target date of 1982. Storing the raw data for the sake of information alone is a costly "diary" operation. Processing of the data for decision making is only alluded to in minor entries in figures 9.8 and 9.9 and is not elaborated in the text.

A centralized system may be quite logical for Virginia's geographical make-up and political disposition. Montana is very unlike Virginia and caution should be excercised in centralizing any data system.

Assessment of the Kansas Water Use Data System.

The Kansas Water Use Data System (KWUDS), another of three prototype systems sponsored by the U.S. Geological Survey, was "scoped" by a a steering committee consisting of representatives from every state agency with possible interest. The committee's findings were documented in a report (2).

Summary of KWUDS.

The KWUDS was identified as having two major functions: support of the Kansas Water Rights Program, and support of the NWUDS.

The data elements dictionary consists of the NWUDS state-level data elements. The "data model" groups data elements into cohesive blocks called entities. For example, the entity "water-right" is broken down into further entities such as diversions, comments, points of use, etc.

Administration of the system is divided into three parts: data management (system input), user liaison (system output), and performance monitoring (system processing). The Kansas Division of Water Resources (DWR) will administer the system with technical assistance from the Department of Computer Services (DCS). The system is scheduled to become operational by the end of 1980.

Implementation uses the "top-down" (macro-to-micro) approach with six major functions broken down into tasks and tasks broken dowm into activities. The six major functions are:

1. Review and consolidate existing analysis.

2. Design data base and support software.

3. Develop and implement data base and support software.

4. Meet staffing requirements.

5. Document capabilites.

6. Train users.

Both automated and manual data systems were identified in a survey of existing state systems. Interfacing with these systems is planned.

Hardware requirements were determined by DCS in a minimal configuration to consist of a large mainframe plus peripheral devices, currently on hand or available through procurement.

Three major software functions were identified:

1. Conversion/collection

    a. automated

    b. partially automated

    c. manual

2. Edit/update

    Editing

    a. physical (numerical data)

    b. logical (consistency of data)

    Updating

    a. add

    b. delete

c. modify

3. Retrieval

a. "generalized" approach (greater computing power)

b. "menu" approach (easier to use)

An inverse relationship exists between computing power and ease of use.

An operational design is ensured by tracing the flow of data through the system for each of the three major software functions. The project management plan poses to identify and plan the tasks necessary to implement KWUDS. The plan follows the top-down approach.

Critique.

The Kansas water rights program and associated administrative controls preceded the KWUDS by more than thirty years. This fact, and the fact that USGS is a major funding source for KWUDS accounts for the very narrow definition of the system's function.

Commendable Features. The system concept (input, process, output) and flow through the system, prerequisites to successful design, were employed. Its operational design was well illustrated in the report. The excellent description of software requirements is also notable. A "data model" is employed as an abstract tool for presenting data elements without reqard to any particular data management system. The project management plan incorporates the modern macro-to-micro approach.

Questionable Features. The Kansas Division of Water Resources is reported as the only state agency which will use the data base to fulfill official responsibilities (historically, administration of water rights). Broadening the definition of function to emphasize the "supply side" might well be the key to participation by other agencies.

Another possible explanation for nonparticipation by other state agencies is the high degree of centralization. A distributed system with cross-indexing of available data might very well appear attractive to other agencies, as each agency would retain custody of its own data base system. Much greater flexibility in meeting different data needs would be possible with a decentralized system.

Assessment of the Idaho Water Use Data System.

The Idaho Water Use Data System (IWUDS) is the third of three prototype data base systems which were examined. Developed with funding assistance by the USGS, the original report (3) tended to be superficial. It was prepared as a part-time assignment by one individual but is now in the process of being updated by Ann Woodward and Gwen McGarvey of the Idaho Department of Water Resources (IDWR). One day was spent in Boise reviewing their rough draft of the updated version.

Summary of IWUDS.

The designers of IWUDS chose to depart from the USGS prototype followed by Virginia and Kansas, yet the function-tool-activity framework and data-elements dictionary aptly reflect macro-to-micro systems analysis concepts.

An initial survey of all water user groups was conducted to determine the type of data currently being collected and possible interest in a cooperative venture. This included surveying all industries listed in the Manufacturing Directory of

Idaho 1978-1979. For municipal water-use figures, IDWR contracted with the Association of Idaho Cities to do a cooperative study. IDWR also contracted with the agency that collects agricultural water-use data for publication in the Idaho Agricultural Statistics Bulletin.

The key to other agency participation in Idaho was found to be "back scratching", which has taken the following forms: IDWR has federal funds or can direct agencies to federal funding sources for help in developing their own expertise. Idaho Fish and Game has a manual fish inventory system. IDWR has agreed to computerize their inventory system in exchange for comprehensive data on minimum flows, fisheries, recreation, local information, water sources, etc. Through the Boise Project Board of Control, IDWR has gained access to monthly ditch rider reports and daily water records for a pilot project in the Boise vicinity. IWUDS will set up programs to aid local and state data users in retaining and interpreting data. Ditch rider report forms have been designed to be more useful to the rider and to local and state data users for predicting future irrigation needs. Similar arrangements are being established with local water masters, e.g., water released into major laterals and wasteways from principal water sources.

An irrigation inventory system is being patterned after the one used in Florida for the Swanee River Agricultural Diversions, and will incorporate sampling stratified by similar water-use characteristics, without replacement. The data being sought include:

1. Length of time an irrigation system is used.

2. Operating capacity of the system.

3. Weather and climate information.

4. Crop schedule and demands.

5. Owner information

6. Location of systems

7. Sources of water

The water rights portion of IWUDS handles the documentation of water licenses, permits, and state claims. ADABAS is the data base management system with updating and retrieval handled by IDWR only. This system has the capability of calling out specific information, e.g., all water rights with a point of diversion in NWSW, Section 3, Township 37N, Range 3W. (Idaho state law requires S, T, R designation.)

Well log data will be collected to provide information on:

1. How many wells exist in a particular 1/4 1/4 S, T, R (will allow comparison with water right records).

2. Geological strata - material structure and water table.

3. Usage - stock, irrigation, domestic.

4. Well drilling work in a particular year.

Geographical Information System (GIS) software is being considered for the foundation of IWUDS since it closely coincides with the features planned for IWUDS:

1. Data acquisition.

2. Data input.

3. Data retrieval and analysis.

4. Information output.

5. Information use.

6. Data management.

An agricultural economic model called BUDGET was demonstrated by Jim Wrigley of IDWR economic section. This interactive program processes raw data into useful information. The program asks the user for location, crop, fertilizer, and irrigation categories, and provides total revenue by crop and net returns to management, land, and water.

Critique.

IWUDS' progress to date clearly indicates that it is a departure from the Virginia and Kansas systems, and local USGS officials are highly supportive of this system. Local USGS officials are highly supportive of the system being developed for a Rocky Mountain State.

Commendable Features. The "back scratching" method for obtaining other agency participation appears to be quite effective. Each participating agency receives immediate assistance in return for its cooperation with the system. Surrendering data management to an outside agency with the promise of easier retrieval and manipulation at some future time in the future is an uncertain business. Through Idaho's cooperative arrangement, an individual agency can choose either to rely on outside support or to retain its own capabilities.

Program development has produced practical survey forms and data input forms for keypunching. Several demonstration programs are now operational providing additional impetus for the successful completion of the system.

IWUDS ignores the overcomplicated "point, reach, area" concept of the Virginia system and instead utilizes a "source-flow" concept. The data elements dictionary has been modified to accommodate this new concept. A workable schematic has been developed.

Questionable Features. The premise of a centralized system (residing under the auspices of a single lead agency, IDWR) seems outmoded in terms of present-day technology which readily permits network connections in a decentralized system.

REFERENCES

1. Laura, D., Virginia Water Use Data System: Part I Requirements, Draft Report of the Virginia Water Use Data System Task Force to the Governor's Office and the United States Geological Survey, December, 1978.

2. Harding, J.W., Kansas Prototype Water Use Data System: System Documentation, CACI, Inc., December 15, 1978.

3. Kennedy, S.K., The Idaho Water Use Data System, Idaho Department of Water Resources, February, 1980.

APPENDIX B

REVIEW OF STATE AND FEDERAL DATA SYSTEMS

Introduction

Thirteen federal and state agencies were interviewed to determine what water data systems were currently used in Montana. In addition, printed materials available from these and other agencies were reviewed and integrated into the assessment process. Following is a brief summary and evaluation of each water data system currently being used by the various agencies. Table 1 shows the types of information collected by each agency or type of organization.

United States Geological Survey. The USGS has one of the most complete water data systems in the United States. The system is designed to store and retrieve flow and quality data for surface and groundwater. Retrieval can be based on location, specific site, basin, and so on. Most, if not all water data is computerized and available on request.

The USGS data system is actually split into two major subsystems, called WATSTORE and SYSTEM 2000. WATSTORE is the data processing system handling surface flow and all water quality data, while SYSTEM 2000 is used for the remaining groundwater information.

The USGS collects some water use data for various groundwater studies being done in the state. Thus, in groundwater study areas, some wells are inventoried to determine location, water levels, well yield, and various other data important to the individual study efforts. None of the studies presently underway attempts to measure or quantify actual water use: instead they are aimed at determining and describing aquifer capacity. The data are computerized and stored in a System 2000 data base and would thus be accessible by the state. Data items are usually collected only once as required for the individual project study. Many data items

stored in System 2000 may thus be totally outdated, particularly for older projects.

TABLE 1. INFORMATION COLLECTED BY AGENCIES

Agency	Streamflow	Well Yields	Water Quality	Diversion	Climate	Reservior Storage	Soils	Land Use	Fish & Wildlife	Recreation
USGS	C	C	C	-	-	-	-	-	-	-
EPA	C	C	C	-	-	-	-	P	C P	-
BLM	P	P	P	C1 P	-	C1 P	P	P	P	P
USFS	C P	-	P	-	P	-	P	P	P	P
SCS	C	-	P	-	C	P	C1 P	P	-	P
WPRS	C	-	P	P	P	P	-	-	-	P
OSM	P	P	P	-	P	-	P	P	P	-
USFWS	C	-	C	-	C	-	-	C	C	-
WQB	C P	C P	C P	C P	-	-	-	P	P	-
DNRC-OGCD	-	P	P	P	-	-	-	-	-	-
DNRC-Water Resources	C	C	-	C	P	C1 P	-	P	-	P
WQB	C P	C P	C P	C P	-	-	-	P	P	-
MBMG	C P	C P	C P	C P	-	-	-	-	-	-
FWP	C P	-	C P	-	-	-	-	P	C P	P
MSU	C	C	C	-	C	-	C	C	-	-
DSL	P	P	P	P	P	P	P	P	P	P
Municipalities	-	P	P	P	-	P	-	P	-	P
Irrigation Districts	-	-	-	P	-	P	P	P	-	-
Industrial Users	P	P	P	P	P	P	-	-	-	-

1 Will be computerized in near future
P = Some data exists only on paper copy
C = Some data is computerized

Environmental Protection Agency (EPA). A number of federal, state, and local agencies use the storage/retrieval (STORET) system developed by EPA. This system is used mainly for water quality and biological data processing, and can be used directly for obtaining statistical information about specific sampling sites.

The EPA attempts to monitor all pollution discharges to major waterways in the state. All major point discharges are covered, and some attempt has been made to quantify and locate major non-point sources as well. The pollution data are all computerized and stored in the national STORET data base system. Items of interest for water use purposes include the location of discharge points, quantity and type of discharge, and the type of facility making the discharge (e.g., municipal sewage treatment plant, industrial water user, etc.).

Bureau of Land Management (BLM). The BLM has initiated a comprehensive program to inventory water use on BLM lands for water rights adjudication purposes. All data inventories will be computerized and stored on a Fort Collins computer along with similar data from the Forest Service. Data items to be inventoried will include location of use, kind of use, amount of consumptive use, description of source, reservoir capacity, spring discharge, etc. Approximately 10,000 data items will be inventoried within the next year. Most consumptive use data will be derived from water right claims and from production estimates. Little or no actual measuring of water use is anticipated. The BLM is collecting vegetative, soils, and benthic data, most of which will be computerized. These data, and data collected by the USGS, are used for all BLM planning, EIS work, and Coal Management Framework Plans.

Future data requirements of the BLM include the ongoing collection of flow, water quality, vegetative, soils, and benthic data. Much of the data collection

will be contracted to the USGS or contractors, but some reconnaissance level resource data collection will be done by BLM. Most of this data will be computerized.

U. S. Forest Service (USFS). The USFS initiated an aggressive water use inventory program similar to the BLM program just described. The USFS has essentially completed the data gathering process and presently has data housed in the Fort Collins computer. As in the case of the BLM program cooperation has been maintained between the USFS and DNRC concerning mutual use of the data for water rights adjudication purposes.

The USFS uses flow and quality data supplied mainly by the USGS and EPA data systems. They collect some of their own instantaneous water data which then goes into STORET (EPA). There is a national effort to establish a computerized soils inventory data base. Much of the USFS soils data is gathered by the SCS, which also supplies snow survey data. Fire weather data (computerized) and some precipitation data (paper copy) is collected by the USFS. Computerized weather data are also available from the U. S. Weather Service.

Soil Conservation Service (SCS). The SCS has a snow survey network (SNOTEL) of 63 sites, of which 45 are operating. These sites measure daily temperature, accumulated precipitation, and snow water equivalent, and transmit the data directly to microprocessers in Portland. The SCS uses snowpack information from these automated stations and numerous other snow measurement sites to forecast streamflows for reservoir management.

The SCS, with the USFS and DNRC, is also involved in identifying forest resources. This inventory should provide useful vegetative and land use data applicable to the hydrologic system.

The SCS does not have any present or proposed future programs directed toward water use data collection. Water use estimates have previously been made by the SCS for various water planning programs such as the Westwide Study and the Level B river basin studies. A fairly detailed inventory of estimated irrigation water use and irrigation efficiency was performed for the Westwide Study and was subsequently published as the Water Conservation and Salvage Report for Montana (1978).

Measured or recorded data on water diverted for irrigation from SCS projects would be available from local irrigation or conservation districts. The data collected may vary from project to project, and none of it is computerized.

Future data needs of the SCS include computerized soils data, and real time access to computerized daily USGS flow records. Also, access to Montana Power Company daily streamflow data and Water and Power Resources Service reservoir inflow data would allow better field checks of streamflow forecasts and help to increase forecast accuracy. Knowledge of stream diversions would be necessary for accurate forecasting.

Water and Power Resources Service (WPRS). Water use studies have been done by WPRS in conjunction with the various river basin planning efforts. Most notably, WPRS has undertaken a comprehensive depletions study for the Missouri River basin in which municipal, agricultural, livestock and industrial water use have been estimated.

In the various WPRS projects, monthly water distribution sheets are available that show actual quantities diverted, estimates for main canal and lateral loss, and estimated farm deliveries. These water distribution data are not computerized, but should be available for all WPRS projects.

The WPRS uses USGS flow data for sizing reservoirs, and water supply, water quality, return flow mixing, and power feasibility studies. Occasionally WPRS will contract, or do inhouse, a special study of a specific area. These studies involve data collection and provide information which is a published report (not computerized). Computerized data is used via a terminal located in Billings which is connected to the USGS data system in Reston, Virginia. The same terminal is used to access WPRS data stored in Denver.

Primary data needs include continuation of USGS streamflow and water quality stations, and computerization of irrigation districts' diversion measurements.

Office of Surface Mining (OSM). The OSM uses data gathered by private companies submitting mine permit applications, the MBMG, the USGS, and other agencies involved in mine permitting. Present data handling involves use of hard copy data, although much of it is on computer at other agencies. Data are used for infiltration studies, mine suitability analysis, universal soil loss research, and groundwater quantity and quality analysis. The OSM will acquire a Techtronics terminal that will tie into the USGS system and will be linked nationwide to the data pool.

Future data needs include a wide ranged data base for assessing cumulative hydrologic impacts of several mines. This data base would include surface and ground water flow rates and quality, climate data, topography, stream diversions,and aquifer withdrawals.

Fish and Wildlife Service (FWS). The FWS uses the Fort Collins computer system for the storage of water quality, flow, vegetation, terrestrial and precipitation data on specific projects. They have the capability of digitizing topographic maps and have inhouse (Fort Collins) software for data processing. The

Billings office has a Techtronics terminal that accesses the USGS and WPRS data systems. The FWS has inhouse capability to do instream flow analysis. Most of the broad scope water data used by FWS is supplied by the USGS and WPRS, while site-specific data is collected inhouse.

The FWS has many site-specific reports that are not computerized. Most of this data is not well organized and would be difficult to standardize for a computer format. Future data needs include streamflow, water quality, and climate data and better access to digitized topographic information. These data will be used to determine cumulative impacts.

Department of Health and Environmental Science (DHES). The Water Quality Bureau (WQB) of the DHES developed a computerized water data handling system in 1973 storing and retrieving water quality data, and making statistical analyses of that data. The WQB has a terminal connected to the state IBM computer where the data are actually stored. The WQB system also uses computerized flow and quality data available from the USGS files. Data collected by the WQB before 1973 is not computerized but could be organized fairly easily for coding and entering. The WQB maintains a computerized inventory of public water supplies. This includes surface and groundwater supplies with an estimate of population served. The WQB uses its data to determine appropriate stream classifications, discharge permit requirements, and water quality standards, and to document water quality violations and health hazards. Additional future data uses include assessing solution mining impacts and developing of suitable aquifer reclamation techniques.

Future data needs include the ongoing collection of water quality and flow data. The data system should be improved to include biological data and to simplify editing of all types of data. Stream modeling requires better access to

diversion, climate, streamflow, biological, soils and land use data. In turn, instream flows and water reservations analyses depend on accurate stream modeling.

Department of Natural Resources and Conservation (DNRC). Two divisions of the DNRC collect and process a significant amount of water use data. The Oil and Gas Conservation Division (OGCD) is responsible for obtaining production and injection records for producing oil wells, water supply and injection wells used for water flooding, and disposal wells. These records are supplied to OGCD by oil field operators on paper forms. Currently these are filed in paper form by OGCD, but plans include putting all production and injection data on computer in the near future.

The Water Resources Division (WRD) collects and uses water data for engineering studies, flood plain management, planning, water rights adjudication and permitting, and for weather modification studies. The DNRC has a staff committed to the development and maintenance of several software systems which handle water data in the areas described above. The current adjudication of water rights will provide a computerized file of claimed use rights throughout the state. New appropriations data and water reservations information will also be collected.

Future data requirements include accurate and current information concerning diversions and instream water uses, and better access to the supply (flow) data collected by USGS and other agencies. These needs are the prime reasons for the DNRC having assumed the lead role in developing the Montana Water Use Data System.

Montana Bureau of Mines and Geology (MBMG). The MBMG collects a large amount of ground and surface water quality data, well information, and geologic data. Most of this data is computerized as it is collected and analyzed. The Bureau uses the information to develop geologic maps and groundwater quality overlays for

topographic base maps, and to assess mining impacts on groundwater quality. A number of Groundwater Situation Reports have also been published by MBMG but are not computerized. The Bureau has developed a very useful computerized data system which should be easily adaptable to any proposed centralized system.

The MBMG's future data needs include aquifer characteristics, thermal springs, soil moisture, climate, and surface flow data. These data will be used to identify better mining techniques suited to Montana, and to minimize environmental impacts.

Fish, Wildlife and Parks(FWP). The FWP has developed a computerized system for processing lake and stream fishery data. This system includes water quality, fisheries, biological and flow data, but very little diversion or water use data.

Future data needs include flow duration hydrographs, diversion data and digitizing streams for computer mapping. Future work with instream flows and water reservations will require easily accessible flow and use data to enable FWP to assess impacts on fish and aquatic animals.

Montana State University (MSU). Montana State University maintains a comprehensive computerized data system which processes flow, climate, soils, snowpack and crop information. This system can be used to predict crop water use but it is not used for collecting actual diversion data. The university has developed a state water planning model that can use data supplied by USGS, the SCS SNOTEL network, weather stations, and soils surveys.

Future data needs include accurate knowledge of actual diversions and water use quantities. Flow, water quality, topographic, climate, and aquifer data are needed for modeling, and soils data now being collected in various counties need to

be computerized. Integrations of these data can then be used for predictive EIS work.

Department of State Lands (DSL). State Lands acquires a large amount of water data from private companies and individuals applying for mine permits. Flow, quality, and aquifer characteristics data are required by DSL for assessing environmental impacts of proposed surface mines. As a result, most of this information is available in paper form and comes from the coal field areas and several large hardrock mining areas. The DSL requires some documentation of proposed water uses for dust control and mineral processing.

Future data needs include site-specific water flow and quality data for mine permitting work, and regional data for cumulative impact assessment due to large-scale (many mines) mining in southeastern Montana.

Municipalities. Communities having centralized water distribution systems generally maintain fairly accurate records of water use. These records are almost always in paper form and are used for billing water customers. Data needs are generally limited to water supply and quality.

Irrigation Districts. Irrigation districts commonly have some form of allocation system for individual users. Some districts maintain accurate flow records based on pumping rates, flume measurements, or ditch water levels. Many districts or large irrigation systems only estimate flows, however, and do not record actual diversions by individual users. It is also doubtful that any districts have computerized data handling systems. Most smaller districts probably would not benefit greatly by computerizing their data.

Data needs of the districts are probably limited to crop requirements, weather forecasts, streamflow, water quality, and possibly streamflow forecasts. A district's participation in the statewide data system would likely then be to exchange its water diversion data for the state's water supply information.

Industrial Water Users. The main industrial uses of water in Montana are for power generation, cooling, mineral processing. Major users include the Montana Power Company, the Anaconda Company, and ASARCO. Major users in the future include owners of coal conversion facilities, coal slurry pipelines, and alcohol production plants. Industrial users generally have accurate records of water use and might be willing to exchange that data for direct access to the centralized water use data system. Water rights data filed by users would be another source of information. This data will eventually be computerized by the DNRC Water Rights Bureau.

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